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Pneumopericardium and Pneumothorax Complicating Bronchogenic Carcinoma

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PNEUMOPERICARDIUM AND PNEUMOTHORAX are extremely rare complications of bronchogenic carcinoma. We present a man with far-advanced carcinoma of the lung in whom a pneumothorax first developed, then a pneumopericardium during the course of illness.

Report of a Case

A 64-year-old man, a security guard, was admitted to the Los Angeles County, University of Southern California Medical Center on June 3, 1974 with a three month history of right-sided chest pain, progressive dyspnea, productive cough, night sweats, weakness and a weight loss of 50 pounds. Findings on a roentgenogram of the chest taken at an outside hospital two months before admission had shown a lesion in the right lung. On bronchoscopy, carried out two weeks before admission, no abnormalities were noted. The patient had been smoking one to two packages of cigarettes for 50 years.

On admission, blood pressure was 108/76, pulse 70, respiration 18 and temperature 36.7°C (98°F). The patient was cachectic but in no acute distress. There were decreased expansion, vocal fremitus and breath sounds on the right side. On percussion of the right side of chest, tenderness and flatness were noted. Heart sounds were within normal limits. Results on the rest of the physical examination were unremarkable. Hemoglobin was 12.5 grams per 100 ml, and leukocyte count 4,900 with a normal differential. Serum calcium was 10.3 mg per 100 ml and albumin was 3.2 grams per 100 ml. On a roentgenogram of the chest, bullous changes were seen as well as a pleural effusion on the right side, with the suggestion of a mass in the right lower lobe (Figure 1). Thoracentesis yielded 750 ml of amber colored fluid with a specific gravity of 1.016 and protein of 3.9 grams per 100 ml. Many lymphocytes were seen but there were no malignant cells. Tuberculin, coccidioidin and histoplasmin skin tests gave negative results after 48 hours. Results of multiple sputa studies for acid-fast bacilli were negative.

On fiberoptic bronchoscopy, carried out on June 13, an infiltrative lesion was seen narrowing the right main stem bronchus. Although an attempt at biopsy of the lesion was unsuccessful, the next day the patient expectorated a piece of tissue, which on microscopic examination indicated keratinizing squamous cell carcinoma. On a roentgenogram of the chest taken 12 days later (June 25), the pleural effusion was seen to have recurred (Figure 2). Other than the previously existing bullae, there was no evidence of air in the chest cavity. Radiotherapy with cobalt-60 was begun. The subsequent course of the patient was complicated by hypoalbuminemia, hyponatremia,

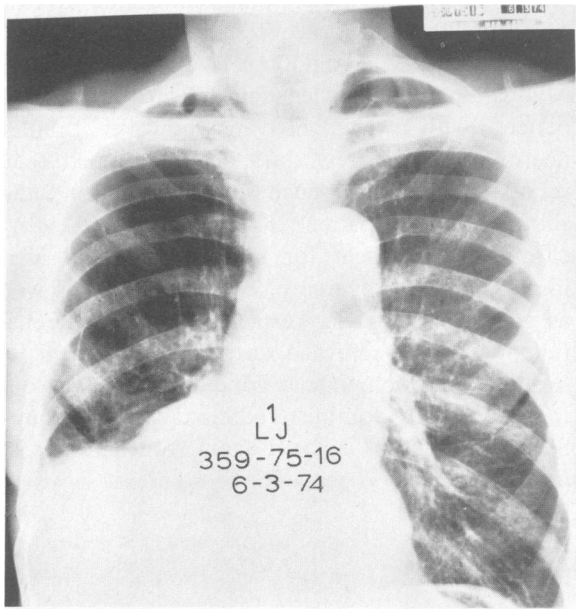

Figure 1.—Admission roentgenogram of chest showing pleural effusion and suggestion of mass in right lower lobe. Note extensive bullous changes at both apices.

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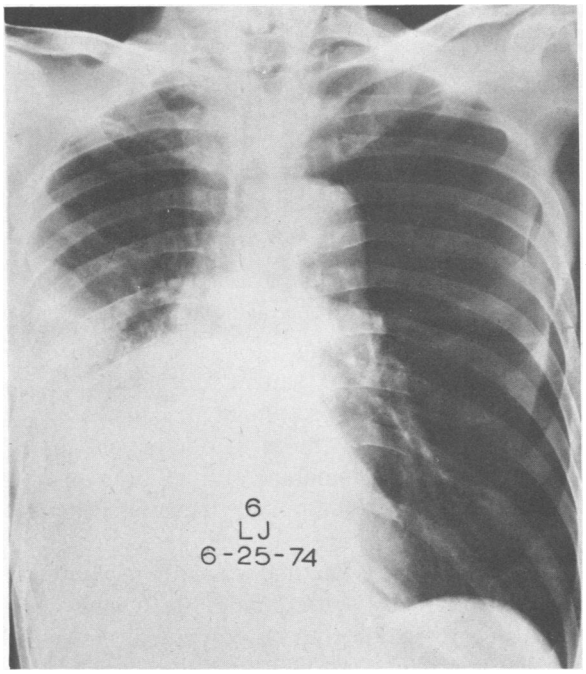

Figure 2.—Roentgenogram of chest on 23rd hospital day showing reaccumulation of fluid following thoracentesis. Note absence of air in chest cavity and pericardium.

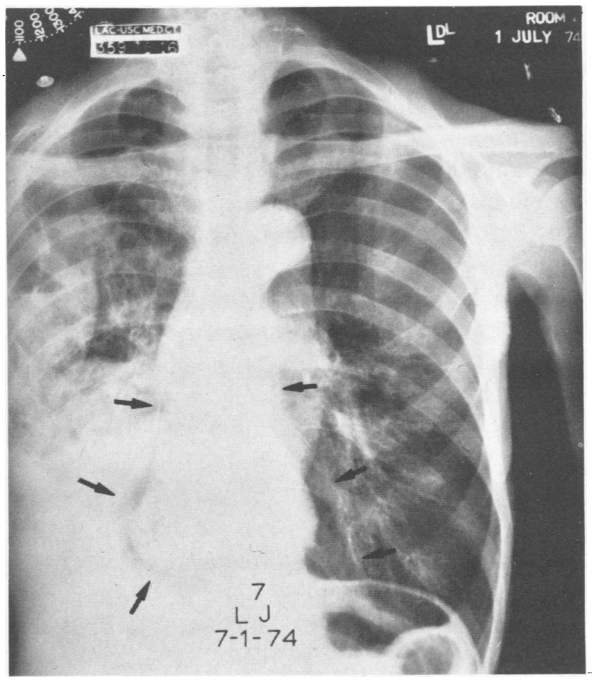

Figure 3.—Roentgenogram of chest on 28th hospital day showing pneumopericardium (arrows). Note also small pneumothorax at right upper lung field.

hypercalcemia (serum calcium rose to 12.5 mg per 100 ml), confusion and a right facial hemiparesis. Saline solutions, albumin, oxygen (given nasally) and high calorie supplements were administered.

On July 1, findings on a roentgenogram of the chest showed the presence of a small pneumothorax as well as a pneumopericardium (Figure 3). The patient's blood pressure fell to 80/60 and the pulse rate rose to 116, although no signs of shock were seen. On auscultation of the heart, a grating, swishing sound coincident with heart sounds ("water-wheel murmur") was noted. The pneumopericardium was noted to persist until the pleural effusion reaccumulated. Although there was temporary improvement of both subjective and objective clinical status, the patient's course was one of progressive deterioration and he died on July 24, the 51st hospital day. Autopsy was not carried out.

Discussion

Malignant tumors of the lung have been reported to be associated with pneumothorax and pneumomediastinum, but it is of interest that most of these have occurred with metastatic bone sarcomas.[1,2] Heimlich and Rubin[3] and Citron[4] reported several cases in which a primary bronchial carcinoma was associated with spontaneous pneumothoraces.

Although pneumopericardium in association with primary bronchial carcinoma is a rare event, it has been seen as a complication more commonly with other problems. Meyer[5] lists trauma, perforated visci, systemic infections (rarely with gas forming organisms), perforation of malignant tumors into the pericardium and primary suppurative pericarditis as the major causes of this entity. Although trauma is the most common cause, perforated esophageal and peptic ulcerations have particularly occupied the interest of thoracic surgeons because of their unique anatomic locations as well as because of their grim prognosis.[6-9]

Until recently, the only malignant tumors reported in association with pneumopericardium have been esophageal and, rarely, gastric carcinoma.[10,11] Harris and Kostiner[12] were the first to report a case of bronchogenic carcinoma involving a pneumopericardium. Ours is therefore the second such case reported in the English language literature.

The signs and symptoms are usually characteristic in pneumopericardium. Unless the patient

had prior reason for chest discomfort (as ours did), there is usually a sudden onset of precordial pain, dyspnea, cyanosis and venous distention. There may be increased tympani as well as widening of the area of cardiac dullness. A loud splashing sound similar to the one heard in our patient can be auscultated in synchrony with systole, the so-called "water-wheel murmur."[7] On a roentgenogram of the chest, the pericardial cavity is found to be dilated more to the left than to the right.[6,12] The air is cut off superiorly by the aortic arch. Because of the hollow pericardial space, cardiac movements are particularly active and this is readily detectable on fluoroscopy.[6]

These features help to distinguish this entity from pneumomediastinum (mediastinal emphysema). In the latter, symptoms are those of severe substernal chest pain, occasionally radiating to the back, neck or shoulders. However, there are usually no constitutional symptoms, such as those suggestive of decreased cardiac output.[13] Auscultatory findings show a "Hamman's crunch" which has a more bubbling, popping or crackling sound than that which is heard with a pneumopericardium. This is often accompanied by subcutaneous crepitation. Pneumothoraces have been observed with mediastinal emphysema and it is thought they are due to the escape of interstitial air into the pleural space through the mediastinum.[13] Contrary to findings with a pneumopericardium, a roentgenogram in pneumomediastinum shows air in the mediastinal tissues *above* the level of the aortic root. Often air is seen running into the neck and above the clavicles.

The reasons for the appearance of air within the pericardium may be several:

- Direct invasion of the tumor into the pericardium with perforation due to necrosis, thus creating a bronchopericardial fistula.
- Possible trauma to the necrotic tumor by bronchoscopy. This is unlikely in our case in view of the fact that the pneumopericardium appeared more than two weeks after the bronchoscopy was carried out. Indeed, findings on a roentgenogram of the chest taken 12 days following bronchoscopy failed to show air in the pericardium.
- Another possibility is an indirect mechanism of the tumor. Lobar collapse by tumor and effusion of part of the right lung already involved by bullous emphysema could lead to overexpansion with rupture of a bulla into the pericardium (through a necrotic focus). This mechanism has been postulated by Citron as a possible cause of pneumothorax in bronchogenic carcinoma.[4] It is of interest that in our patient bullous disease was also present at the time of diagnosis, and a small pneumothorax was noted at the time the pneumopericardium developed.

We are unaware of any instance in which a direct causal relationship between pneumothorax and pneumopericardium has been shown.

Unfortunately, the lack of an autopsy prevented us from determining the exact cause of the findings in this case.

Harris and Kostiner's patient with pneumopericardium died rapidly, presumably because of cardiovascular collapse.[12] Since in our patient there was no associated hemopericardium or pyopericardium, pericardial tamponade was not seen and this aspect of the disease probably did not contribute to his death. Pneumopericardium is, however, a potentially fatal condition. It must be treated aggressively with a combined medical-surgical approach.[5,7-9] This involves pericardiocentesis, appropriate antimicrobial therapy and, when the patient's condition allows, surgical drainage.

Summary

Pneumopericardium and pneumothorax associated with primary bronchial carcinoma are extremely rare findings. We present a patient in whom such an entity developed during the course of illness. Characteristic physical and roentgenographic findings were present. The pathogenesis, clinical presentation and course of this disease are discussed.

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